01/20/00 jc685 U.S. PTO

NONPROVISIONAL PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

OLIFF & BERRIDGE, PLC
P.O. Box 19928
Alexandria, Virginia 22320
Telephone: (703) 836-6400
Facsimile: (703) 836-2787

Attorney Docket No.: 105273

Date: January 20, 2000

BOX PATENT APPLICATION

NONPROVISIONAL APPLICATION TRANSMITTAL
RULE §1.53(b)

jc625 U.S. PTO 09/488803 01/20/00

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Transmitted herewith for filing under 37 C.F.R. §1.53(b) is the nonprovisional patent application

For (Title): A SPINDLE MOTOR FOR DISK DRIVING DEVICE

By (Inventors): Oswald KUWERT, Juergen OELSCH and Kenji FUKUNAGA

- ☒ Formal drawings (Figs. 1-2; 2 sheets) are attached.
- ☒ A Declaration and Power of Attorney is filed herewith.
- ☒ An assignment of the invention to MINEBEA CO., LTD. is filed herewith.
- ☐ An Information Disclosure Statement is filed herewith.
- ☐ A statement to establish small entity status under 37 C.F.R. §§1.9 and 1.27 is filed herewith.
- ☒ A Preliminary Amendment is filed herewith.
- ☐ Please amend the specification by inserting before the first line the sentence --This nonprovisional application claims the benefit of U.S. Provisional Application No. _____, filed _____.--
- ☒ Priority of foreign application No. 11-235454 filed August 23, 1999 in Japan is claimed (35 U.S.C. §119).
- ☒ A certified copy of the above corresponding foreign application is filed herewith.
- ☒ The filing fee is calculated below:

CLAIMS IN THE APPLICATION AFTER ENTRY OF ANY PRELIMINARY AMENDMENT NOTED ABOVE

FOR:	NO. FILED	NO. EXTRA	SMALL ENTITY RATE	SMALL ENTITY FEE		OTHER THAN A SMALL ENTITY RATE	OTHER THAN A SMALL ENTITY FEE
BASIC FEE				$ 345	OR		$ 690
TOTAL CLAIMS	7 - 20	= 0	x 9 =	$	OR	x 18	$ 0
INDEP CLAIMS	1 - 3	= 0	x 39 =	$	OR	x 78	$ 0
☐ MULTIPLE DEPENDENT CLAIMS PRESENTED			+130 =	$	OR	+260	$ 0
			TOTAL	$	OR	TOTAL	$ 690

* If the difference is less than zero, enter "0".

- ☒ Check No. 105838 in the amount of $690.00 to cover the filing fee is attached. Except as otherwise noted herein, the Commissioner is hereby authorized to charge any other fees that may be required to complete this filing, or to credit any overpayment, to Deposit Account No. 15-0461. Two duplicate copies of this sheet are attached.
- ☐ This application is entitled to small entity status. DO NOT charge large entity fees to our Deposit Account.

Respectfully submitted,

James A. Oliff
Registration No. 27,075

Thomas J. Pardini
Registration No. 30,411

JAO:TJP/kmc

Inventor Information

Inventor One Given Name::	Oswald
Family Name::	Kuwert
Name Suffix::	
City of Residence::	Am Sonnenberg
State or Prov. of Residence::	
Country of Residence::	Germany
Inventor Two Given Name::	Juergen
Family Name::	Oelsch
Name Suffix::	
City of Residence::	Saaleblick
State or Prov. of Residence::	
Country of Residence::	Germany
Inventor Three Given Name::	Kenji
Family Name::	Fukunaga
Name Suffix::	
City of Residence::	Kitasaku-gun
State or Prov. of Residence::	
Country of Residence::	Japan
Inventor Four Given Name::	
Family Name::	
Name Suffix::	
City of Residence::	
State or Prov. of Residence::	
Country of Residence::	
Inventor Five Given Name ::	
Family Name::	
Name Suffix::	
City of Residence::	
State or Prov. of Residence::	
Country of Residence::	

Correspondence Information

Name Line One::	Oliff & Berridge PLC
Address Line One::	P.O. Box 19928
City::	Alexandria
State or Province::	VA
Postal or Zip Code::	22320
Telephone::	(703) 836-6400
Fax::	(703) 836-2787
Electronic Mail::	commcenter@oliff.com

Application Information

Title Line One::	A Spindle Motor For Disk Driving
Title Line Two::	Device
Title Line Three::	
Title Line Four::	

Total Drawing Sheets::	2
Docket Number::	105273

Continuity Information

>This application is a::
Application One::
Filing Date::
Patent Number::
which is a::
>>Application Two::
Filing Date::
Patent Number::

Prior Foreign Applications

Foreign Application One::	11-235454
Filing Date::	August 23, 1999
Country::	Japan
Priority Claimed::	yes
Foreign Application Two::	
Filing Date::	
Country::	
Priority Claimed::	
Foreign Application Three::	
Filing Date::	
Country::	
Priority Claimed::	

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Oswald KUWERT, Juergen OELSCH and Kenji FUKUNAGA

Application No.: New U.S. Patent Application

Filed: January 20, 2000 Docket No.: 105273

For: A SPINDLE MOTOR FOR DISK DRIVING DEVICE

PRELIMINARY AMENDMENT

Assistant Commissioner of Patents
Washington, D. C. 20231

Sir:

Prior to initial examination, please amend the above-identified application as follows:

IN THE CLAIMS:

Please amend claims 3 and 4 as follows:

Claim 3, line 2, delete "or 2".

Claim 4, lines 1-2, change "any one of Claims 1 to 3" to --Claim 1--.

Please add claims 5-7 as follows:

--5. A spindle motor for a disk driving device according to Claim 2, wherein said housing and a spacer between the bearings are molded in a unitary manner.--

--6. A spindle motor for a disk driving device according to Claim 2, wherein the housing and an electric supplying connector are molded in a unitary manner.--

--7. A spindle motor for a disk driving device according to Claim 3, wherein the housing and an electric supplying connector are molded in a unitary manner.--

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REMARKS

Claims 1-7 are pending. By this Preliminary Amendment, claims 3 and 4 are amended to eliminate multiple dependencies. Claims 5-7 are added to compensate for the subject matter deleted from multiple dependent claims 3 and 4. No new matter is added. Prompt and favorable examination on the merits is respectfully solicited.

Respectfully submitted,

James A. Oliff
Registration No. 27,075

Thomas J. Pardini
Registration No. 30,411

JAO:TJP/kmc

OLIFF & BERRIDGE, PLC
P.O. Box 19928
Alexandria, Virginia 22320
Telephone: (703) 836-6400

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A SPINDLE MOTOR FOR DISK DRIVING DEVICE

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to a spindle motor suitable for a disk driving device for such as hard disk drive, optical disk drive and removal type of disk drive.

Related art

Fig. 1 is a sectional view of a spindle motor for disk driving device. This spindle motor is used for a so called a removal type of disk drive (ZIP), in which a disk i.e. a recording medium can be replaced upon necessity. And, the spindle motor of Fig. 1 is a so called "shaft rotation type" of spindle motor, in which a shaft 2 is mounted on a rotor 1, the shaft 2 is supported on a housing 5 through a bearing 3.

The rotor 1 comprises a circular disk putting face 1a, around its circumferential end portion, an outer circumferential cylinder portion 1b is formed in unitary manner. And, on an inner wall of the outer circumferential cylinder portion 1b, a magnet 1c is mounted. In the illustrated example, although the shaft 2 is pressed in and fixed on the central portion of the rotor 1, there is another example in which the shaft 2 is formed in a unitary manner with the rotor 1. Now, since the spindle motor shown is for a ZIP, on the disk putting face 1a too, a magnet 1d for functioning as a disk clamper.

Further, in the spindle motor shown in Fig. 1, in order to increase a rotation precision of the rotor 1, two bearings 3 are used so as to clamp a spacer 4. In the housing 5 to be fixed with an outer ring of the bearing 3, a stator 6 is fixed. A copper wiring 7 to supply electricity to a coil 6a supported at the stator 6 is connected to a flexible printed circuit board (FPC) 8 through an opening 5a formed on the housing 5. Further, the spindle motor for disk driving device comprises identical structure in general not limited to the one for ZIP.

Now, recently the operation speed of computer has been increased greatly, accordingly to an information memory medium

such as disk drive a further increased capacity has been requested. In general, in order to increase a memory capacity per disk, it is necessary to narrow a track width for writing and reading. However, if a rotation deflection of a spindle motor is great, it becomes difficult to trace such track by the head for writing and reading. In other word, it becomes quite important to increase the rotation precision of the spindle motor so as to increase the memory capacity of the disk driving device. So that, a high precision of parts are requested for components of the spindle motor, and a housing 5 as a basic structure of the spindle motor has been prepared by applying a cutting work by using a NC working machine to a metal material such as aluminous and ferrous materials.

However, a housing to be prepared by cutting work is not preferable in view of a cost reduction. Initially, the cutting work itself is evaluated highly priced from the viewpoint of cost reduction in a mass production. Further, since a surface treatment for corrosion protection is indispensable due to a metal-made, the cost reduction has been made difficult.

Further, although a conventional spindle motor has been developed to increase the rotation precision as a primary target, due to the recent time's demand, it has been mentioned as a problem to be solved to reduce a rotation noise.

The present invention has been made in the light of the above problem, the purpose thereof is to reduce the cost of the components of the housing of the spindle motor and also to diminish the rotation noise of the spindle motor. In addition, further increase of the rotation precision of the spindle motor is intended.

Summary of the invention

The spindle motor for the disk driving device according to a first aspect of the present invention, so as to solve the above problem, is what comprises a housing holding a stator and a rotor having a magnet on a cylindrical portion of a circumference and both are supported in such a manner as they are able to rotate relatively through a shaft and bearings, wherein the housing is made of a resin.

According to this invention, the housing can be obtained by an injection molding. Further, since it is made of a resin, after molding it in a necessary configuration, it is not necessary to apply a corrosion protection treatment.

In addition, since the housing bears a given resiliency, it becomes possible to absorb a vibration, to deteriorate a rotation noise.

Further, the spindle motor for disk driving device according to a second aspect of the present invention the housing of which is formed with a super engineering plastic. The super engineering plastic is, comparing with a general plastic resin, high in heat resistance, superior to in strength property, low in heat expansion property, and is able to obtain a state of orientation, all of which properties are required for a material of the housing for a spindle motor for the disk driving device.

Further, the spindle motor for the disk driving device according to a third aspect of the present invention is formed by molding the housing and a spacer between bearings in a unitary manner. Accordingly, it can be intended to reduce the number of components and assembling processes.

Further, the spindle motor for the disk driving device according to fourth aspect of the present invention, the housing and an electric supplying connector are molded in a unitary manner. By this invention too, it can be intended to reduce the number of components and assembling processes for disk driving device.

Brief description of the drawings

Fig. 1 is a sectional view of one embodiment of the shaft rotation type of spindle motor for disk driving device.

Fig. 2 is a sectional view of one embodiment of the shaft fixed type of the spindle motor.

Embodiment

Hereinafter, one embodiment of the present invention is explained referring to attached drawings for disk driving device.

In the embodiment of the present invention, as a housing ZIP shown in Fig. 1, a resin molding due to an injection molding is used.

As concrete examples of the resin, a super engineering plastic such as liquid crystal polymer (LCP), polyphenylene sulfide (PPS), polyethersulfon (PES) and polysulfon (PSF) are exemplified.

These super engineering plastics are high in heat resistance, superior in strength, low in heat expansion and obtainable easy orientation. Accordingly, the housing 5 formed with these materials can have mechanical properties not inferior to the conventional metal made housing. Further, since it can be produced by an injection molding, the cost reduction is greatly expected by a mass production.

Further, for instance, it becomes easier to mold the housing 5 and the spacer 4 between the two bearings 3, and it can be intended to reduce the numbers of the components of the spindle motor and the assembling processes. In addition, the housing 5 and the electric supplying connector can be molded in a unitary manner, thereby the identical effect can be obtained. And, in the conventional metal made housing, it has been necessary to conduct an insulating measures such as covering the copper wire 7 with insulating tube, interposing an insulator between the opening 5a of the housing and inserting an insulating shim between the coil 6a and the housing 5, however, according to the embodiment of the present invention, since the housing 5 itself has an insulating property, such measures are adapted to become unnecessary. As a result, the cost of the parts to be used for the insulating measures and the number of assembling processes are reduced and the cost for the spindle motor can be reduced. In addition, since the corrosion protection is not necessary to the housing, from this point too, comparing with the conventional metal made housing, the production cost can be held low.

Now, as a method for molding the housing 5 and the electric supplying connector in a unitary manner, the followings are mentioned: (1) the housing 5 is formed by injection molding while providing tiny holes for connectors opened by necessary numbers, after the molding the connector pins are pressed in the holes, (2) the completed connectors are inserting-molded with the housing 5,

(3) providing through holes to make the coil or lead come through, and those are drawn out through these holes to connect to the FPC or connectors, (4) a necessary number of connector pins are molded with the housing 5 by inserting molding.

Further, since the housing 5 itself has a high resiliency compared with the conventional metal made housing, for instance, the vibration transmitted from the rotor 1 to the housing 5 through the bearings 3 and the vibration due to the electric switching of the stator 6 may be diminished by absorbing-function of the housing 5 itself. Thus, the vibration which causes a rotation noise can be absorbed by the housing 5, and comparing with the conventional metal made housing, the rotation noise of the spindle motor can be reduced.

Further, since the housing 5 itself has a high resiliency, comparing with the conventional metal made housing, it is possible to further increase the rotation precision of the spindle motor. The reason is as follows: the conventional metal made housing causes to make the outer ring (metal made) of the bearing 3 distorted due to its rigidity to deteriorate the rotation precision of the bearing 3. However, in the embodiment of the present invention, it is not to distort the outer ring of the bearing 3 but to cause the housing to be distorted, so that there is no chance to deteriorate the rotation precision of the bearing itself. Accordingly, the shaft 2 is adapted to be supported in high precision to increase the rotation precision of the spindle motor.

Now, in the embodiment of the present invention, the housing 5 is exemplified as being made of resin, but it is also possible to make the rotor 1 and/or the shaft 2 made of a resin. In addition, in place of the conventional plastic magnet, a rubber magnet is used, then further cost down is intended.

In Fig. 2, so-called "shaft fixed type" spindle motor is shown, in which the shaft 2 is fixed on the housing 5 and the rotor 1 is supported on the shaft 2 through the bearing 3. The spindle motor of Fig. 2 is formed in such a manner as the outer rings of the two bearings 3 is made in a unitary manner to omit the spacer 4 which

is used in the "shaft rotary" type of spindle motor and the inner ring of the bearing 3 positioned lower is formed with the shaft 2 in a unitary manner. Further, since the spindle motor shown in Fig. 2 is not for ZIP, the disk putting face 1a of the rotor 1 is not provided with the magnet 1d to function as a disk clamper. Further, the parts or portions identical with or relevant to the ones in Fig. 1 are indicated identically.

Also in this "shaft fixed type" spindle motor shown in Fig. 2, by making the housing 5 made of resin, the effect as well as in the case where the housing 5 of the spindle motor of Fig. 1 is made of resin, can be obtained.

Example

Hereinafter, in the shaft rotary type of spindle motor shown in Fig. 1, what differences of the cost, rotation noise and rotation precision between the conventional metal made housing 5 and the one which is made of the super engineering plastic of the present invention are there are compared as follows.

Comparing the spindle motor with the conventional spindle motor; first, from cost viewpoint, 33 to 50 % is reduced. Further, as to the rotation noise, in the case at 25 cm far from the motor, 8 % of noise reduction is measured. Further, as to the rotation precision, it is observed that Non-Repetitive-RunOut is improved in the axial direction of the shaft 2 by 5.5 % and in the radial direction by 15 %.

From a viewpoint of the material cost, when comparing the four kind of super engineering plastic, the LCP is highest followed by the PES, the PSF and the PPS in order.

Since the present invention is thus constituted, the following effects are derived therefrom. First, according to the first feature of the spindle motor of the present invention, it is possible to reduce the manufacturing cost of the spindle motor by reducing the cost of the parts of the housing of the spindle motor. Also, it is possible to reduce the rotation noise of the spindle motor and make a further increasing of the rotation precision.

Further, according to the second aspect of the spindle motor of

the present invention, it becomes possible to a desired mechanical property to obtain a highly functional spindle motor, even though the housing is made of a resin. Further, according to the third and fourth aspects of the spindle motor, it becomes possible to provide a spindle motor for a disk driving having desired functions at a low cost.

What is claimed is:

1. A spindle motor for a disk driving device comprising a housing holding a stator and a rotor at an outer circumference of which a magnet is provided, which are supported mutually rotatively through a shaft and a bearing, wherein said housing is made of a resin.
2. A spindle motor for a disk driving device according to Claim 1, wherein said housing is formed with a super engineering plastic.
3. A spindle motor for a disk driving device according to Claim 1 or 2, wherein said housing and a spacer between the bearings are molded in a unitary manner.
4. A spindle motor for a disk driving device according to any one of Claims 1 to 3, wherein the housing and an electric supplying connector are molded in a unitary manner.

Abstract of the disclosure

If the motor housing 5 is manufactured with a resin, the housing 5 becomes possible to be manufactured by injection molding, so that the housing 5 can be intended to lower the manufacturing cost by a mass production. Further, the counter measures for insulation such as covering a copper wire 7 with an insulating tape, interposing an insulator to an opening 5a of the housing installing an insulating shim between the coil 6a and the housing 5 become unnecessary. As a result, it becomes possible to expect a cost down of the spindle motor due to the reduction of the cost of the parts for insulating members and the mounting processes. And, further, since a vibration transmitted from the rotor 1 through the bearing and a vibration caused by an electric switching of the stator 6 etc. are diminished due to elastic absorbing function of the housing 5, rotation noise of the spindle motor can be reduced.

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Fig. 1

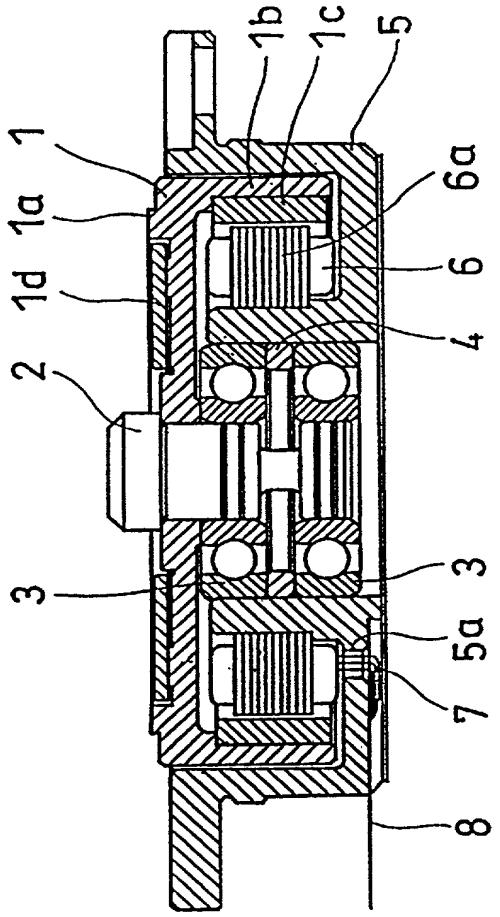
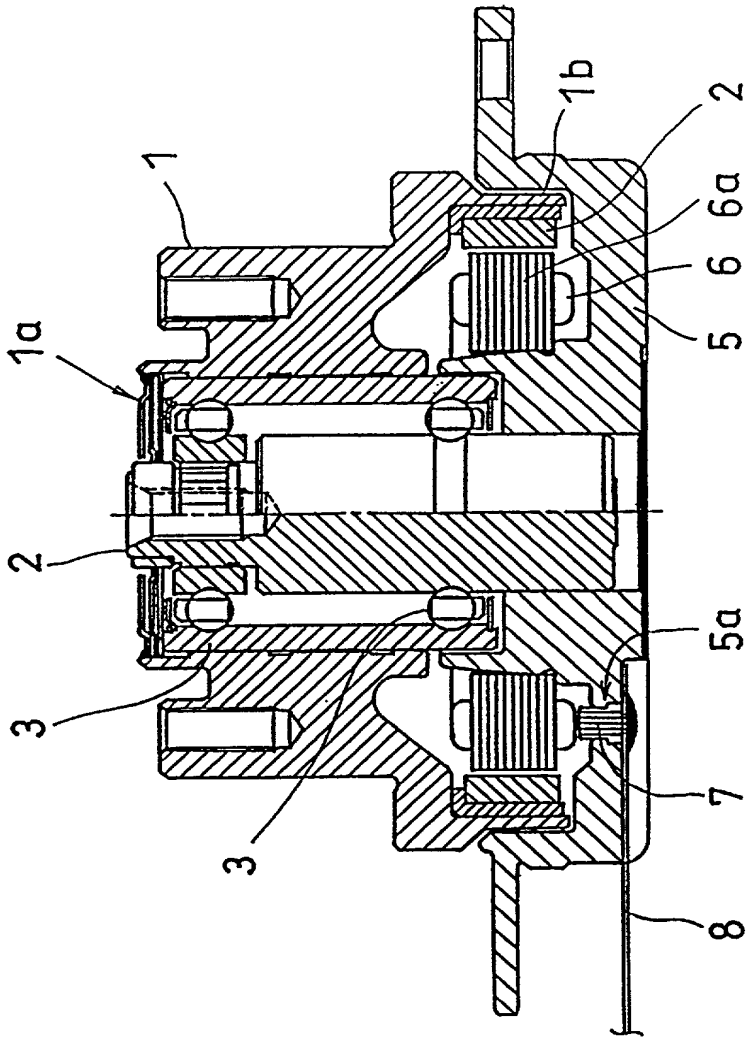


Fig. 2



Docket No.: 105273

APPLICATION FOR UNITED STATES PATENT DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; that

I verily believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

A SPINDLE MOTOR FOR DISK DRIVING DEVICE

described and claimed in the specification:

Check one

*a. ☒ attached hereto.

b. ☐ filed on _____ as Application No. _____ and amended on _____. (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56. Under Title 35, U.S. Code §119, the priority benefits of the following foreign application(s) and/or United States provisional application(s) filed within one year prior to this application are hereby claimed:

Japanese Patent Application No. Hei 11-235454 filed on August 23, 1999

The following application(s) for patent or inventor's certificate on this invention were filed in countries foreign to the United States of America either (a) more than one year prior to this application, or (b) before the filing date of the above-named foreign priority application(s) and/or United States provisional application(s):

I hereby appoint the following as my attorneys of record with full power of substitution and revocation to prosecute this application and to transact all business in the Patent Office:

James A. Oliff, Reg.No.27,075; William P. Berridge, Reg.No.30,024; Kirk M. Hudson, Reg.No.27,562; Thomas J. Pardini, Reg.No.30,411; and Edward P. Walker, Reg.No.31,450.

ALL CORRESPONDENCE IN CONNECTION WITH THIS APPLICATION SHOULD BE SENT TO OLIFF & BERRIDGE, P.O. BOX 19928, ALEXANDRIA, VIRGINIA, 22320, TELEPHONE (703) 836-6400.

I hereby declare that I have reviewed and understand the contents of this Declaration, and that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Typewritten Full Name of Sole or First Inventor	Oswald		Kuwert
	Given Name	Middle Initial	Family Name
**Inventor's Signature	Oswald Kuwert		
** Date of Signature	NOV 11th 1999		
	Month	Day	Year
Residence	Am Sonnenberg	Tutschfelden	Germany
	City	State or Province	Country
Citizenship	German		
Post Office Address (Insert complete mailing address, including country)	Am Sonnenberg 8, 79336, Tutschfelden, Germany		

***This form may be executed only when attached to the specification (including claims) at the end thereof if Box a. is checked.**

****Note to Inventor: Please sign name exactly as it appears above and insert actual date of signing.**

IF THERE IS MORE THAN ONE INVENTOR USE PAGE 2 AND PLACE AN "X" HERE ☒

AGE 2 OF U.S.A. DECLARATION FORM
(Discard this page in a sole inventor application)

Typewritten Full Name of Second Joint Inventor (if any) **Juergen** (Given Name) **M** (Middle Initial) **Oelsch** (Family Name)

**Inventor's Signature

*Date of Signature 11 (Month) 29 (Day) 1999 (Year)

Residence Saaleblick (City) Hohenroth (State or Province) Germany (Country)

Citizenship German

Post Office Address Saaleblick 23, 97618, Hohenroth, Germany

(Insert completing mailing address, including country)

Typewritten Full Name of Third Joint Inventor (if any) **Kenji** (Given Name) (Middle Initial) **FUKUNAGA** (Family Name)

**Inventor's Signature

*Date of Signature Nov. 25th (Month) (Day) 1999 (Year)

Residence **Kitasaku-gun** (City) **Nagano-ken** (State or Province) **Japan** (Country)

Citizenship **Japanese**

Post Office Address **c/o Minebea Co., Ltd. Karuizawa Manufacturing Unit**

(Insert completing mailing address, including country) **4106-73 Miyota, Miyota-machi, Kitasaku-gun, Nagano-ken, Japan**

Typewritten Full Name of Fourth Joint Inventor (if any) (Given Name) (Middle Initial) (Family Name)

**Inventor's Signature

*Date of Signature (Month) (Day) (Year)

Residence (City) (State or Province) (Country)

Citizenship

Post Office Address

(Insert completing mailing address, including country)

Typewritten Full Name of Fifth Joint Inventor (if any) (Given Name) (Middle Initial) (Family Name)

**Inventor's Signature

*Date of Signature (Month) (Day) (Year)

Residence (City) (State or Province) (Country)

Citizenship

Post Office Address

(Insert completing mailing address, including country)

**** Note to Inventors: Please sign name exactly as it appears and insert the actual date of signing. This form may be executed only when attached to the first page of the Declaration and Power of Attorney form of the application to which it pertains.**

DO NOT ENTER ABOVE THIS LINE